

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A publish/subscribe messaging system, comprising:
at least one broker and at least one subscriber, wherein the at least one broker has having means for sending a status request message to the at least one subscriber, and means for receiving an indication of liveness of the subscriber.
means, responsive to each subscriber receiving the status request message from the at least one broker, for setting a timer for each subscriber of the at least one subscriber, and
means, responsive to the timer expiring, for sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber.
2. (Currently Amended) The publish/subscribe messaging system of claim 1, further comprising:
~~wherein the subscriber has~~
means for sending a status response message from the particular subscriber to the at least one broker, wherein the status response message is an indication of liveness of the at least one subscriber. ~~to indicate liveness.~~
3. (Currently Amended) The publish/subscribe messaging system of claim 1, further comprising:
~~wherein the means for receiving comprises~~
means for listening on a multicast channel by the at least one broker, and
means for determining an indication of non-liveness from failure to receive a response from the at least one subscriber.
4. (Currently Amended) The publish/subscribe messaging system of claim 2, wherein the means for sending ~~[[a]]~~ the status response message from the particular subscriber to the at least one broker further comprises:
means, responsive to the particular subscriber sending the status response message, for suppressing sending of [[the]] a separate status response message from another subscriber of the at least one subscriber. ~~if at least another subscriber sends a status response message.~~

5. (Currently Amended) The publish/subscribe messaging system of claim 4, wherein sending the status response message is responsive to sending the multicast message claiming response, and wherein the means for suppressing ~~sending of the status response message~~ further comprises:

~~means for setting a timer upon receipt of a status request message from the broker;~~

~~means for sending, on expiry of the timer, a multicast message claiming response to the broker;~~

~~means, responsive to the another subscriber of the least one subscriber receiving the multicast message claiming response, for cancelling the timer and discarding the status request message for the another subscriber, if the subscriber receives a message claiming response from another subscriber; and~~

~~means for sending the status response message to the broker following sending a message claiming response.~~

6. (Currently Amended) The publish/subscribe messaging system of claim 5, ~~wherein the broker~~ further ~~comprises~~ comprising:

~~means, responsive to the at least one broker failing to receive the multicast message claiming response from the at least one subscriber, for re-sending the status request message, if it does not receive a response thereto.~~

7. (Currently Amended) The publish/subscribe messaging system of claim 4, wherein the means for suppressing further comprises: ~~sending of the status response message is arranged to~~

~~means, responsive to a desired plurality of subscribers of the at least one subscriber sending the status response message, for suppressing suppress sending of the separate status response message from the another subscriber, if at least a desired plurality of other subscribers send a status response message.~~

8. (Currently Amended) The publish/subscribe messaging system of claim 7, wherein the status request message comprises a parameter representative of the desired plurality of subscribers, wherein sending the status response message is responsive to sending the multicast message claiming response, and wherein the means for suppressing sending of the separate status response message from the another subscriber further comprises: ~~sending of the status response message comprises:~~

~~means for setting a timer upon receipt of a status request message from the broker, the status request message containing a parameter representative of the desired plurality of other subscribers;~~

~~means for sending, on expiry of the timer, a multicast message claiming response to the broker;~~

~~means, responsive to the another particular subscriber receiving the multicast message claiming response from the desired plurality of subscribers, for cancelling the timer and discarding the status request message for the another particular subscriber, if the subscriber receives messages claiming response from the desired plurality of other subscribers; and~~

~~means for sending the status response message to the broker following sending a message claiming response.~~

9. (Currently Amended) The publish/subscribe messaging system of claim 1, [[5]] wherein the timer has a random duration.

10. (Currently Amended) The publish/subscribe messaging system of claim 1, further comprising:
~~wherein at least one of the subscribers is arranged to~~

~~means for maintaining maintain~~ an active connection between the particular subscriber and [[to]]
the at least one broker, wherein the active connection is established during registration, and

~~means for indicating liveness to the at least one broker using established during registration, and to use the active connection, to indicate liveness to the broker.~~

11. (Currently Amended) The publish/subscribe messaging system of claim 10, further comprising:
~~wherein the subscriber has~~ means for sending a status response message from the particular subscriber to the at least one broker to indicate the liveness, and wherein the means for sending a status response message to the broker comprises

~~means, responsive to the particular subscriber sending the status response message, for suppressing sending of [[the]] a separate status response message from another subscriber, and if at least another subscriber sends a status response message, wherein the means for suppressing sending of the status response message further comprises:~~

~~means, responsive to determining for checking, upon receipt of a status request message from the broker, whether that the particular subscriber has [[an]] the active connection to the at least one broker, for and if so performing one of A) and B): A) sending a multicast response claim message, and sending [[a]] the status response message to the at least one broker via the active connection, and connection; B) setting a timer and then sending [[a]] the multicast message claiming response [[claim]] and [[a]] the status response message to the at least one broker via the active connection upon expiry of the timer. connection; and~~

~~means for, following sending of a multicast response message, establishing an active connection to the broker if not already established and sending the status response message to the broker via the active connection.~~

12. (Currently Amended) [[A]] The publish/subscribe messaging system according to claim 1, wherein the at least one broker is arranged to designate as ~~a primary subscriber~~ a first subscriber to register interest in a topic as a primary subscriber, and to maintain an active connection to the primary subscriber for sending the status request message directly to the primary subscriber ~~a status request message~~, and ~~in the event of failure of the primary subscriber to send a status request message to at least one other subscriber~~ and to designate a different subscriber as a new primary subscriber in response to a failure of the primary subscriber to send an indication of liveness and in response to the different subscriber sending the indication of liveness. ~~the at least one of the other subscribers whose indication of liveness is next first received.~~

13. (Currently Amended) The publish/subscribe messaging system of claim 10, wherein the active connection is a transmission control protocol/internet protocol TCP/IP connection.

14. (Currently Amended) The publish/subscribe messaging system of claim 1, wherein the status request message is piggybacked onto another multicast publication message.

15. (Currently Amended) The publish/subscribe messaging system of claim [[1]] 2, wherein the indication of liveness is sent over one ~~[[of:]] of a user datagram protocol connection UDP connection;~~ and a transmission control protocol ~~[[TCP]]~~ connection.

16. (Currently Amended) The publish/subscribe messaging system of claim 15, wherein ~~[[the]]~~ a connection over which the indication of liveness is sent is arranged to escalate autonomously from ~~[[a UDP]]~~ the user datagram protocol connection to ~~[[a TCP]]~~ the transmission control protocol connection in response to an absence of the event of no responses being received by to the at least one broker within a chosen time period.

17. (Currently Amended) A method for liveness monitoring in a publish/subscribe messaging system having at least one broker and at least one subscriber, the method comprising:

~~at the broker,~~ sending a status request message from the at least one broker to the at least one subscriber, ~~[[and]]~~

responsive to each subscriber receiving the status request message from the at least one broker,
setting a timer for each subscriber of the at least one subscriber, and

responsive to the timer expiring, sending a multicast message claiming response to the at least
one broker from a particular subscriber of the at least one subscriber.

~~receiving an indication of liveness of the subscriber.~~

18. (Currently Amended) The method of claim 17, further comprising:

~~at the subscriber,~~ sending a status response message from the particular subscriber to the at least
one broker, wherein the status response message is an indication of liveness of the at least one subscriber.
~~to indicate liveness.~~

19. (Currently Amended) The method of claim 17, ~~wherein the step of receiving comprises~~ further
comprising:

listening on a multicast channel by the at least one broker, and

determining an indication of non-liveness from failure to receive a response from the at least one
subscriber.

20. (Currently Amended) The method of claim 18, wherein ~~the step of sending the status response~~
~~message from the particular subscriber to the at least one broker~~ a status response message to the broker
further comprises:

responsive to the particular subscriber sending the status response message, suppressing sending
of [[the]] a separate status response message from another subscriber of the at least one subscriber, if at
least another subscriber sends a status response message.

21. (Currently Amended) The method of claim 20, wherein sending the status response message is
responsive to sending the multicast message claiming response, and wherein the ~~step of~~ suppressing
~~sending of the status response message~~ further comprises:

setting a timer upon receipt of a status, request message from the broker;

performing one of A) and B):

A) — sending, on expiry of the timer, a multicast message claiming response to the broker;

responsive to the another subscriber of the least one subscriber receiving the multicast message claiming response, [[B)]] cancelling the timer and discarding the status request message for the another subscriber, if the subscriber receives a message claiming response from another subscriber; and sending the status response message to the broker following sending a message claiming response.

22. (Currently Amended) The method of claim 21, further comprising: [[,]] responsive to [[at]] the at least one broker failing to receive the multicast message claiming response from the at least one subscriber, re-sending the status request message, if the broker does not receive a response thereto.

23. (Currently Amended) The method of claim 20, wherein the step of suppressing sending of the status response message further comprises:
responsive to a desired plurality of subscribers of the at least one subscriber sending the status response message, suppressing sending of the separate status response message from the another subscriber, if at least a desired plurality of other subscribers send a status response message.

24. (Currently Amended) The method of claim 23, wherein the status request message comprises a parameter representative of the desired plurality of subscribers, wherein sending the status response message is responsive to sending the multicast message claiming response, and wherein the step of suppressing sending of the separate status response message from the another subscriber sending of the status response message further comprises:

setting a timer upon receipt of a status request message from the broker, the status request message containing a parameter representative of the desired plurality of other subscribers;

performing one of A) and B):

A) — sending, on expiry of the timer, a multicast message claiming response to the broker; responsive to the another particular subscriber receiving the multicast message claiming response from the desired plurality of subscribers, [[B)]] cancelling the timer and discarding the status request message for the another particular subscriber, if the subscriber receives messages claiming response from the desired plurality of other subscribers; and

sending the status response message to the broker following sending a message claiming response.

25. (Currently Amended) The method of claim 17, ~~[[21]]~~ wherein the timer has a random duration.

26. (Currently Amended) The method of claim 17, further comprising:

~~at least one of the subscribers~~, maintaining an active connection between the particular subscriber and [[to]] the at least one broker, wherein the active connection is established during registration.

indicating liveness to the at least one broker established during registration, and using the active connection, ~~to indicate liveness to the broker.~~

27. (Currently Amended) The method of claim 26, further comprising:

~~at the subscriber~~, sending a status response message from the particular subscriber to the at least one broker to indicate the liveness, wherein the step of sending a status response message to the broker comprises

responsive to the particular subscriber sending the status response message, suppressing sending of [[the]] a separate status response message from another subscriber of the at least one subscriber, if at least another subscriber sends a status response message and wherein the step of suppressing sending of the status response message further comprises:

responsive to determining checking, upon receipt of a status request message from the broker, whether that the particular subscriber has [[an]] the active connection to the at least one broker, and if so performing one of A) and B): A) sending a multicast response claim message, and sending [[a]] the status response message to the at least one broker via the active connection; connection, and B) setting a timer and then sending [[a]] the multicast message claiming response [[claim]] and [[a]] the status response message to the at least one broker via the active connection; connection upon expiry of the timer. and

following sending of a multicast response message, establishing an active connection to the broker if not already established and sending the status response message to the broker via the active connection.

28. (Currently Amended) The method of claim 17, further A method of liveness monitoring in a publish/subscribe messaging system having at least one broker and at least one subscriber, comprising:

at the broker, designating as a primary subscriber the a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber, [[and]]

maintaining an active connection to the primary subscriber for sending the status request message directly to the primary subscriber a status request message, and

~~in the event of responsive to a failure of the primary subscriber to send an indication of liveness and responsive to a different subscriber of the at least one subscriber sending the indication of liveness, revert to the request method of claim 17 and designating [[as a]] the different subscriber as a new primary subscriber, the subscriber whose indication of liveness is next first received.~~

29. (Currently Amended) The method of claim 26, wherein the active connection is a transmission control protocol/internet protocol TCP/IP connection.

30. (Currently Amended) The method of claim 17, wherein the status request message is piggybacked onto another multicast publication message.

31. (Currently Amended) The method of claim ~~[[17]]~~ 18, wherein the indication of liveness is sent over one ~~[[of:]]~~ of a user datagram protocol connection UDP connection; and a transmission control protocol ~~[[TCP]]~~ connection.

32. (Currently Amended) The method of claim 31, wherein ~~[[the]]~~ a connection over which the indication of liveness is sent escalates autonomously from ~~[[a]]~~ the user datagram protocol ~~[[UDP]]~~ connection to ~~[[a]]~~ the transmission control protocol ~~[[TCP]]~~ connection in response to an absence of the event of no responses being received by to the at least one broker within a chosen time period.

33.–35. (Cancelled)

36. (Currently Amended) A system subscriber for indicating liveness to a broker in a multicast publish/subscribe messaging system comprising the broker and a plurality of subscribers, the system subscriber comprising:

means, responsive to each subscriber receiving a status request message from the broker, for setting a timer for each subscriber in the plurality of subscribers, and

means, responsive to the timer expiring, for sending a multicast message claiming response to the broker from a particular subscriber in the plurality of subscribers. ~~sending an indication of liveness to the broker.~~

37. (Currently Amended) The system subscriber of claim 36, further comprising:

means for sending a status response message from the particular subscriber to the broker, wherein the status response message is an indication of liveness of the plurality of subscribers. ~~to indicate liveness.~~

38. (Currently Amended) The system subscriber of claim 37, further comprising:
means, responsive to the particular subscriber sending the status response message, for
suppressing sending of [[the] a separate status response message from another subscriber in the plurality
of subscribers, ~~if at least another subscriber sends a status response message.~~

39. (Currently Amended) The system subscriber of claim 38, wherein sending the status response
message is responsive to sending the multicast message claiming response, and wherein the means for
suppressing ~~sending of the status response message~~ further comprises:
means ~~for setting a timer upon receipt of a status request message from the broker;~~
means ~~for sending, on expiry of the timer, a multicast message claiming response to the broker;~~
means, responsive to the another subscriber in the plurality of subscribers receiving the multicast
message claiming response, for cancelling the timer and discarding the status request message for the
another subscriber, ~~if the subscriber receives a message claiming response from another subscriber; and~~
means ~~for sending the status response message to the broker following sending a message~~
~~claiming response.~~

40. (Currently Amended) The system subscriber of claim 38, wherein the means for suppressing
further comprises: sending of the status response message is arranged to
means, responsive to a desired plurality of subscribers of the at least one subscriber sending the
status response message, for suppressing suppress sending of the separate status response message from
the another subscriber, ~~if at least a desired plurality of other subscribers send a status response message.~~

41. (Currently Amended) The system subscriber of claim 40, wherein the status request message
comprises a parameter representative of the desired plurality of subscribers, wherein sending the status
response message is responsive to sending the multicast message claiming response, and wherein the
means for suppressing sending of the separate status response message from the another subscriber further
comprises: sending of the status response message comprises:
means ~~for setting a timer upon receipt of a status request message from the broker, the status~~
~~request message containing a parameter representative of the desired plurality of other subscribers;~~
means ~~for sending, on expiry of the timer, a multicast message claiming response to the broker;~~

means, responsive to the another particular subscriber receiving the multicast message claiming response from the desired plurality of subscribers, for cancelling the timer and discarding the status request message for the another particular subscriber, if the subscriber receives messages claiming response from the desired plurality of other subscribers; and

means for sending the status response message to the broker following sending a message claiming response.

42. (Currently Amended) The system subscriber of claim 36, further comprising:

means for maintaining an active connection between the particular subscriber and [[to]] the broker, wherein the active connection is established during registration, ~~established during registration;~~ and

means for indicating liveness to the broker using the active connection, ~~to indicate liveness to the broker.~~

43. (Currently Amended) The system subscriber of claim 36, further comprising:

means for sending a status response message from the particular subscriber to the broker to indicate liveness, ~~wherein the means for sending a status response message to the broker comprises~~

means, responsive to the particular subscriber sending the status response message, for suppressing sending of [[the]] a separate status response message from another subscriber, and if at least another subscriber sends a status response message and wherein the means for suppressing sending of the status response message further comprises:

means, responsive to determining for checking, upon receipt of a status request message from the broker, whether that the particular subscriber has an active connection to the broker, for and if so performing one of A) and B): A) ~~sending a multicast response claim message,~~ and sending [[a]] the status response message to the broker via the active connection, and ~~connection;~~ B) ~~setting a timer and then~~ sending [[a]] the multicast message claiming response [[claim]] and [[a]] the status response message to the broker via the active connection upon expiry of the timer. ~~connection; and~~

means for, ~~following sending of a multicast response message, establishing an active connection to the broker if not already established and sending the status response message to the broker via the active connection.~~

44. (Currently Amended) A method for indicating liveness to a broker in a multicast publish/subscribe messaging system comprising the broker and a plurality of subscribers, the method comprising: ~~the step of:~~

responsive to each subscriber receiving a status request message from the broker, setting a timer for each subscriber in the plurality of subscribers, and sending an indication of liveness to the broker.
responsive to the timer expiring, sending a multicast message claiming response to the broker from a particular subscriber in the plurality of subscribers.

45. (Currently Amended) The method of claim 44, further comprising: the step of:
sending a status response message from the particular subscriber to the broker, wherein the status response message is an indication of liveness of the plurality of subscribers. to indicate liveness.

46. (Currently Amended) The method of claim 45, comprising:
responsive to the particular subscriber sending the status response message, suppressing sending of [[the]] a separate status response message from another subscriber in the plurality of subscribers. if at least another subscriber sends a status response message.

47. (Currently Amended) The method of claim 46, wherein sending the status response message is responsive to sending the multicast message claiming response, and wherein the step of suppressing further sending of the status response message comprises:
setting a timer upon receipt of a status request message from the broker;
sending, on expiry of the timer, a multicast messaging claiming response to the broker;
responsive to the another subscriber receiving the multicast message claiming response,
cancelling the timer and discarding the status request message for the another subscriber. if the subscriber receives a message claiming response from another subscriber; and
sending the status response message to the broker following sending a message claiming response.

48. (Currently Amended) The method of claim 46, wherein the step of suppressing further comprises:
sending of the status response message is arranged to
responsive to a desired plurality of subscribers of the plurality of subscribers sending the status response message, suppressing suppress sending of the separate status response message from the another subscriber. if at least a desired plurality of other subscribers send a status response message.

49. (Currently Amended) The method of claim 48, wherein the status request message comprises a parameter representative of the desired plurality of subscribers, wherein sending the status response message is responsive to sending the multicast message claiming response, and wherein the step of

~~suppressing sending of the separate status response message from the another subscriber further comprises: sending of the status response message comprises:~~

~~setting a timer upon receipt of a status request message from the broker, the status request message containing a parameter representative of the desired plurality of other subscribers;~~

~~sending, on expiry of the timer, a multicast message claiming response to the broker;~~

~~responsive to the another particular subscriber receiving the multicast message claiming response from the desired plurality of subscribers, cancelling the timer and discarding the status request message for the another particular subscriber, if the subscriber receives messages claiming response from the desired plurality of other subscribers; and~~

~~sending the status response message to the broker following sending a message claiming response.~~

50. (Currently Amended) The method of claim 44, further comprising:

maintaining an active connection between the particular subscriber and [[to]] the broker, wherein the active connection is established during registration, established during registration; and

indicating liveness to the broker using the active connection, to indicate liveness to the broker.

51. (Currently Amended) The method of claim 50, further comprising:

sending a status response message from the particular subscriber to the broker to indicate the liveness, wherein the step of sending a status response message to the broker comprises

responsive to the particular subscriber sending the status response message, suppressing sending of [[the]] a separate status response message from another subscriber, and if at least another subscriber sends a status response message and wherein the step of suppressing sending of the status response message further comprises:

responsive to determining checking, upon receipt of a status request message from the broker, whether that the particular subscriber has [[an]] the active connection to the broker, and if so performing one of A) and B): A) sending a multicast response claim message, and sending [[a]] the status response message to the broker via the active connection, and connection; B) setting a timer and then sending [[a]] the multicast message claiming response [[claim]] and [[a]] the status response message to the broker via the active connection upon expiry of the timer. connection; and

following sending of a multicast response message, establishing an active connection to the broker if not already established and sending the status response message to the broker via the active connection.

52. (Cancelled)

53. (New) The method of claim 17, further comprising:

responsive to sending the multicast message claiming response and responsive to an absence of an active connection between the particular subscriber and the at least one broker, establishing the active connection to the at least one broker and sending a status response message to the at least one broker via the active connection.

54. (New) The publish/subscribe messaging system of claim 1, further comprising:

responsive to sending the multicast message claiming response and responsive to an absence of an active connection between the particular subscriber and the at least one broker, establishing the active connection to the at least one broker and sending a status response message to the at least one broker via the active connection.